EARLY AMERICAN OBSERVATORIES

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WHICH WAS THE FIRST ASTRONOMICAL OBSERVATORY IN AMERICA?

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Published by

WILLIAMS COLLEGE

WILLIAMSTOWN, MASSACHUSETTS

1938

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John Quincy Adams, President of the United States, in his first annual message to Congress on December 6, 1825, said:

> Connected with the establishment of a university, or separate from it, might be undertaken the erection of an astronomical observatory, with provision for the support of an astronomer, to be in constant attendance of observation upon the phenomena of the heavens; and for the periodical publication of his observations. It is with no feeling of pride, as an American, that the remark may be made that, on the comparatively small territorial surface of Europe, there are existing upward of one hundred and thirty of these lighthouses of the skies; while throughout the whole American hemisphere there is not one. If we reflect a moment upon the discoveries which, in the last four centuries, have been made in the physical constitution of the universe by the means of these buildings, and of observers stationed in them, shall we doubt of their usefulness to every nation? And while scarcely a year passes over our heads without bringing some new astronomical discovery to light, which we must fain receive at second-hand from Europe, are we not cutting ourselves off from the means of returning light for light, while we have neither observatory nor observer upon our half of the globe, and the earth revolves in perpetual darkness to our unsearching eyes?

In 1832, Sir George B. Airy, Astronomer Royal of England, in his report on Astronomy before the British Association closed by saying that, as for the United States, he did not know of the existence of a single public observatory within the limits of the entire country.

We may not agree entirely with the above statements but nevertheless the wave of observatory building did not reach America until between 1830 and 1840.

In considering the early American observatories it is convenient to classify them in two entirely different ways. In the first place they may be classified as (1) temporary observatories, (2) makeshift observatories, (3) mere repositories of apparatus, and (4) regular permanent observatories. If a telescope were mounted in the open on a pier and then covered with a shack or shed or canvass tent to make unnecessary the remounting and taking down of the instrument each time it was used, this might well

be considered a temporary observatory. If a mere shack or a building of temporary construction were used to house an instrument for a few months or even a few years it might still be appropriately considered a temporary observatory. If a telescope were placed on the top floor of a building and observations were made through the open windows, this might well be considered a makeshift observatory. If a telescope were kept in a certain room or building along with other apparatus and then taken out into the open to be used, such a building would be a mere repository of apparatus and only by courtesy an observatory in any sense. A regular permanent observatory should have piers for the mounting of the instruments, roof shutters or a revolving dome so that the observations could be made from inside the building, and the construction of the building should be such that it would normally last for a considerable number of years.

Observatories may also be classified as state, private, and public. By a state observatory or institution is meant one which is maintained by the United States Government, or by some state, or in the early days by some colony. The private observatories were owned by individuals and were for three different purposes: (1) for gazing purposes to satisfy intellectual curiosity and interest; (2) for research work; (3) for private gain. This last would be the case if the observatory were used to determine time to rate chronometers which were being constructed or repaired by the owner of the observatory. By a public observatory is meant one owned by some educational institution. These were for astronomical instruction and research.

The stimulus which led to observatory building in America came from three sources. The first was a desire to observe astronomical occurrences and to do research work. A transit of Venus occurred in 1769 and expeditions were sent long distances to observe it. It aroused a very general interest in astronomy. The previous transit in 1761 had not been as favorable and was not as widely observed. In 1833 came a brilliant display of Leonids and everyone was looking forward with eagerness to the return of Halley's comet in 1835. In the second place, the needs of surveying on a large scale brought astronomy into prominence. No sooner had the early colonists come to America than boundary disputes arose everywhere. To settle these disputes and to fix with accuracy the boundaries between the colonies, surveying on

a large scale had to be done. This required the determination of latitude, longitude, time, and azimuth by astronomical methods and with essentially astronomical instruments. It was said in the early days that a mathematician or an astronomer could not earn his living without being either a surveyor or a clock-maker or both. Sometimes not only was a good support provided for the instrument but a shed or tent may have been placed over it. It might be claimed in these cases that a small temporary astronomical observatory had been set up. In the third place, the needs of navigation stimulated the building of observatories. The determination of latitude at sea in the early part of the eighteenth century was not very difficult. The observation of the meridian altitude of some heavenly body by means of a cross staff or a crude early sextant would determine the latitude with fair accuracy. The determination of longitude was, however, extremely difficult. The two rival methods were by means of carrying a timekeeper or by means of lunar distances and neither method was accurate or satisfactory. On land the eclipses of Jupiter's satellites, the occultation of stars by the moon, and the time of occurrence of lunar eclipses could also be used and with far greater accuracy. Before the invention of the telegraph these were, in fact, the five methods of determining longitude. After the invention of the chronometer by John Harrison in 1761 the method of determining the longitude at sea by means of lunar distances gradually fell out of use leaving the chronometer method supreme. The exact determination of time is necessary for the chronometer method since the chronometer must be carefully rated, and the best method of determining time was then by means of a transit instrument and a good clock located in an observatory.

A full consideration of all the observatories in America of the various kinds built and equipped prior to 1840 will illustrate many of the statements which have been made. There are eleven observatories in such a list: one was a private observatory; one was a private observatory which developed into the Harvard College Observatory, first at Dana House and later in its present location; one was a private observatory which developed into the Depot of Charts and Instruments and later into the United States Naval Observatory; and eight were erected by educational institutions. The surveying stations or temporary astronomical observatories in connection with the early boundary surveys and

in connection with the survey of the coast are not included in this number. In fact they are not considered to have been astronomical observatories in any proper sense.

Early Boundary Surveys

Boundary disputes came up everywhere in the colonies. Many colonial grants had been based on parallels of latitude or meridians of longitude. It was no easy matter to mark out these lines. Right here in Williamstown a wrongly run parallel probably places Williamstown in Massachusetts instead of Vermont. The most famous boundary historically is without doubt the Mason and Dixon line between Maryland and Pennsylvania. Mason was an astronomer as well as a surveyor and more astronomical observations were probably made in connection with this line than any other. The dispute which arose between William Penn and Lord Baltimore about the borders of their colonies continued after the death of both parties. In 1732 a first agreement was reached. In 1763 Charles Mason and Jeremiah Dixon, two skilled surveyors, were sent over from England by the Proprietaries to mark the line. Mason had been Bradley's assistant after he had retired as head of the Greenwich Observatory. In 1764 they entered upon their task with good instruments and a number of axemen to serve as helpers. By the middle of June 1765, they had traced the parallel of latitude which was 39° 43′ 26.3″ N to the Susquehanna. A year later they climbed the Little Allegheny. In 1767 they were 244 miles from the Delaware River. Time, azimuth, and latitude and longitude were frequently determined by astronomical observations. The following example, is taken from the *Journal of the Senate of the State of Delaware*, 1841 on. On page 64 commences:

Col. Graham's Report to the Commissioners, Washington, February 7, 1850

To Messrs. H. G. S. Key, Joshua P. Eyre and George Read Riddle, commissioners for adjusting and re-fixing certain parts of the boundaries of the States of Maryland, Pennsylvania and Delaware.

*Note 2. — The latitude of the north wall of this house, occupied in 1763 by Thomas Plumstead and Joseph Huddle, was determined by Messrs. Mason and Dixon, from astronomical observations in 1763-64 with a zenith sector to 39° 56′ 29.1″.

* This note occurs on p. 67.

It is interesting to note the instrument used and the accuracy which was supposed to be attained.

Professor W. C. Rufus of the University of Michigan in his article "Astronomical Observatories in the United States Prior to 1848" in Vol. XIX of the *Scientific Monthly* (August, 1924) has this to say:

> Mason and Dixon arrived from England in 1763 to settle a boundary dispute between Pennsylvania and Maryland. Their first work in this country was to establish a surveying station and to determine its position with great care and accuracy. The building erected for this work just south of the city of Philadelphia, was called Mason and Dixon's Observatory. Extensive astronomical observations were made in 1763 and 1764, and the reduction of the data has been styled the first astronomical computation in America.

Professor Maurice J. Babb of the University of Pennsylvania in his article "David Rittenhouse" in Volume LVI, No. 223, of the *Pennsylvania Magazine of History and Biography* (July, 1932) has this to say:

> We know that . . . . Mason and Dixon, after a short stay at the Plumstead house, No. 30 South Street, designated as the most southerly point of Philadelphia, loaded their instruments in a wagon and went 31 miles directly to what is now called Harlan's Corner, near the Chester County Poor Farm and spent the Winter there, and that there remains in the shifting sands of a field above the house the so-called Star Gazer's stone. Immediately south of the house was their observatory from which they measured a south line crossing the Brandywine three times in the first mile. They continued this and on a part of it measured out a degree of latitude. This line runs over four miles East of the Eastern boundary of Maryland. They probably didn't want to make any of their preliminary calculations on Lord Baltimore's territory. Finally they measured fifteen miles south from the then position of the stone which was in the latitude of the most "southernly part of Philadelphia." From this point they proceeded to locate the Northeastern corner of Maryland and to lay out Mason and Dixon's line. The method was to start off from each station, on the arc of a great circle just as steamers do today, then at intervals they checked back South on the Meridian to the latitude of their starting point. In this manner they continued until stopped by Indians.

There are two articles by Mason and Dixon themselves in the *Transactions of the Royal Society*, Volume 58 (1768). The following are certain extracts from these articles:

> The Place where these observations were made (the Forks of the River Brandiwine) is the Northernmost Point of the Lines that were measured for a degree of latitude . . . . it lies 31 miles West by measurement; and 10."5

South of the Southernmost point of the City of Philadelphia, as found by the Sector.

N.B. The clock was firmly secured to a piece of timber, 22 inches in breadth, and five inches and a quarter thick; the said piece of timber was let four feet into the ground which was composed of a very firm, dry, hard clay. The clock was placed in a tent, with Fahrenheit's thermometer hung to its side.

Time was determined by equal altitudes.

The eclipses of Jupiter's satellites were observed with a reflecting telescope of one foot focus that magnified 70 times.

The astronomical observations had been taken with an excellent sector of six foot radius constructed by Mr. Bird.

The three chief surveying stations, or astronomical observatories if we wish to call them that, were thus located at the Plumstead house in the most southernly part of Philadelphia; at the Forks of the Brandywine, 31 miles west; and at a point about 15 miles south which was the beginning of the Mason and Dixon line. At one of these the clock was attached to a post and covered with a tent. Time was determined by means of equal altitudes using the instrument in the open. Longitude was determined by eclipses of Jupiter's satellites using the instrument in the open. These stations were very temporary, being used for two or three years only. Most agree that they should be considered simply surveying stations and not astronomical observatories.

The United States Coast and Geodetic Survey

During the administration of Thomas Jefferson, Congress passed an act February 10, 1807, authorizing the establishment of a Coast Survey. It was a bureau placed under the Secretary of the Treasury. The latter, with the approval of the President, issued a circular setting forth a project of a survey, inviting the attention of scientists to it, and requesting plans for carrying it into effect. In this project the proposed operations were to consist of: (1) the ascertainment, by a series of astronomical observations, of the true position of a few remarkable points on the coast; (2) a trigonometric survey of the coast between these points; and (3) a nautical survey of the shoals and soundings of the coast, of which the trigonometric survey was to supply the basis.

The plan of work adopted was one which had been submitted by Ferdinand Rudolph Hassler, a Swiss engineer of considerable experience, who at the time was instructor of mathematics at

West Point. Hassler was appointed first superintendent of the "Survey of the Coast." Nothing was done, due to the lack of instruments, until July 11, 1811, when Hassler was sent to Europe to have the necessary instruments constructed and to purchase others. The War of 1812 interfered with the plans and it was 1816 before field work was begun in the bay and harbor of New York. On April 14, 1818, Congress repealed the provisions of the act of 1807. Work was suspended and the instruments, records, and funds were turned over by Mr. Hassler to the War Department. On July 10, 1832, Congress revived the Act of 1807 and Mr. Hassler was again appointed superintendent.

In 1878, the bureau became the Coast and Geodetic Survey. After several attempts to transfer it to the Navy Department had failed, it was finally transferred in 1903 to the Department of Commerce and Labor and in 1913 to the Department of Commerce.

The following are two extracts from reports by Mr. Hassler:

Report of Mr. F. R. Hassler, dated Weasel Mountain, August 6, 1817

The eighteen inch multiplying circle, similar to the one I lent for the determination of the northern boundary, depending, by the nature of its construction, very little on its adjustments, has given me the least trouble, notwithstanding its few adjustments were lost also. I shall stand more in need of this instrument in the field than I thought, as I shall have to observe in lighthouses, steeples, high buildings, where theodolite kind of instruments cannot be used. Besides this, the astronomical observations are to be made by it.

This kind of instrument being best adapted to supply, in an observatory, (the construction of at least one of which becomes now indispensible to the advancement of the survey) the absence of the mural instrument. I must wish very much that the one lent for the boundary, may be returned immediately after that service.

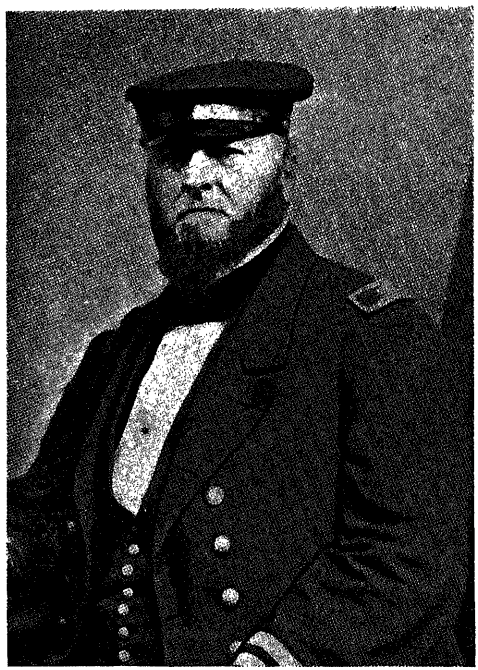
Report of Mr. F. R. Hassler, dated Washington City, May 17, 1834

Upon Buttermilk and Joshua, regular series of azimuth observations with the sun were made with the two feet theodolite, by myself; and the latitudes of all the most essential stations were observed by my assistants, partly with the 18 inch repeating circle, partly with the 10 inch repeating reflecting circle. By the calculations of this winter these latitudes were all reduced to one collective result, by means of the azimuths; and the coincidence has been more satisfactory even than I expected.

These reductions carried through the works of 1817, to the City Hall of New York, the latitude and longitude of which had been determined by entirely different means, gave the points from which the longitudes have been counted, as reduced to Greenwich; there being no other points within the limits of the

survey astronomically determined, nor any fixed point in the United States from which the longitude could be counted.

The various reports of Mr.Hassler are interesting in a great many ways. In the first place, they show clearly that Mr.Hassler never thought of his temporary, makeshift observation stations as constituting astronomical observatories in any sense. Furthermore, as early as 1817 he was adding his voice to the chorus which was already clamoring for at least one national astronomical observatory in the United States. Incidentally the instruments used and the methods of determining time, azimuth, latitude, and longitude are apparent.



LIEUT. L. M. GOLDSBOROUGH, U.S.N.
First Superintendent of the Depot of Charts and Instruments, 1830-1833

The United States Naval Observatory

Thomas Jefferson, as an amateur, made astronomical observations and at one time had a plan for a national observatory.

Barlow's "Prospectus of a National Institution" in 1806 included plans for a national observatory.

Hassler in 1807 and again in 1817 urged the erection of a national observatory.

James Monroe in 1812, when he was Secretary of State, urged it.

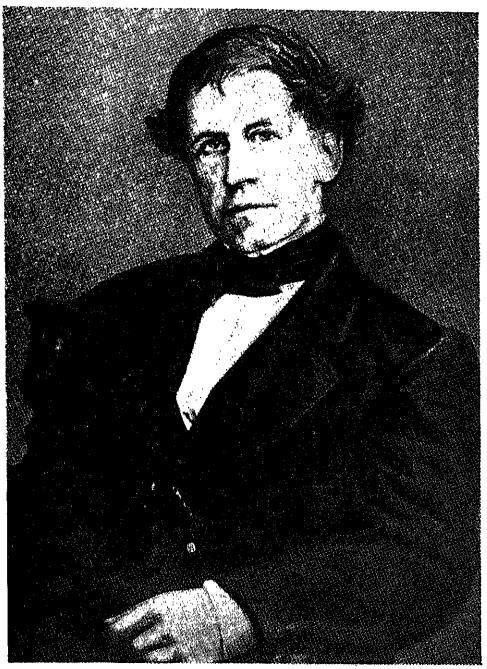
Some of the leading professors of Bowdoin College memorialized Congress to establish it.

William Lambert of Virginia, an amateur astronomer, from

1809 to 1824 made frequent representations to Congress about it.

John Quincy Adams, when President, in 1825, as is stated in the opening paragraph, urged it.

In 1827, Mr. James Courtenay of Charleston published a pamphlet urging the establishment of a national observatory.

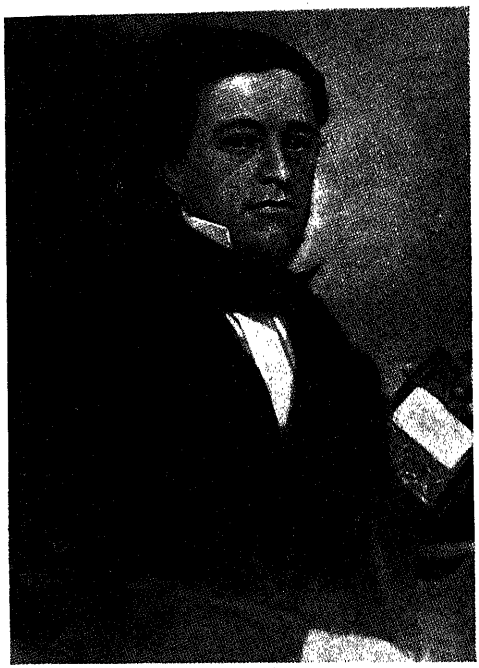


LIEUT. CHARLES WILKES, U.S.N.
Superintendent of the Depot of Charts and Instruments, 1833-1837

The call for a national observatory grew louder and louder as the years passed but Congress did nothing.

On December 6, 1830, the Secretary of the Navy established the Depot of Charts and Instruments and placed Lieutenant L. M. Goldsborough in charge. He was directed to collect from the commandants of the various navy yards the nautical instruments, books, and charts not being used and to deposit them in the Depot. Here they were arranged, marked, and put in condition for reissue. Among his other duties were: the determination of the errors of chronometers; the translation of all books, charts, pamphlets, and other nautical information into English; the reduction of all charts to the meridian of Greenwich. The strange title, Depot of Charts and Instruments, was perhaps chosen to camouflage the idea that there was anything astronomical about it. Lieutenant Goldsborough, however, is said to have mounted a 30 inch transit instrument made by R. Patten of New York on a brick pier in a small circular building. It was located in the square bounded by 24th and 25th Streets, Pennsylvania Avenue and K Street

Northwest. The story goes that he was later told to discontinue the observatory as it was "unconstitutional" for the navy to have an observatory.



LIEUT. JAMES M. GILLISS, U.S.N.
Superintendent of the Depot of Charts and Instruments, 1837-1842

In 1833, Lieutenant (later Captain) Charles Wilkes, a scientist of note, succeeded Lieutenant Goldsborough. He became thoroughly provoked by the procrastination of Congress in providing a suitable building for the Depot and he built his own astronomical observatory with his own money on Capitol Hill, about 1,000 or 1,200 feet north of the Capitol. It was a little building about 16 feet square (14′ by 13′ according to one author) and contained a 4 inch transit instrument made by Troughton in England in 1815 and loaned by the Coast Survey. He also had a 3½ inch portable telescope by Jones, a small, portable transit instrument, a sidereal clock and other equipment. In 1836 he went to Europe to procure instruments for his expedition to the Pacific and the South Seas. The expedition started on its mission in 1838 and returned in 1842. In the meantime, in 1836, Lieutenant James M. Gilliss was ordered to Washington and was soon put in charge of the Depot of Charts and Instruments. He obtained as additional equipment a portable 4½ achromatic telescope, equatorially mounted, a variation transit, a comet seeker, a sidereal chronometer, and later a sidereal and a mean time clock.* In 1838, when Cap-

*The instuments and their dimensions are given with slight differences by different writers.

tain Wilkes took charge of the exploring expedition, he recommended that a series of observations should be taken in this country during his absence upon such celestial phenomena as might be available for the better determination of his longitudes and their reference to some meridian at home. His recommendation was sanctioned and the observations were made in Washington by Lieutenant Gilliss and continued until 1842. In Dorchester, Massachusetts, they were made by William Cranch Bond. Gilliss says:

> From that time (Sept., 1838) till the return of the expedition in 1842, I observed every culmination of the moon and every occultation visible in Washington which occurred between two hours before sunset and two hours after sunrise.
>
> The number of transits recorded exceeds 10,000 embracing the moon, planets, and 1,100 stars. The average annual number of culminations of the moon observed was 110 and of lunar occultations about 20.

These observations by Gilliss (1838-1842) were later published as an octavo volume of 672 pages.

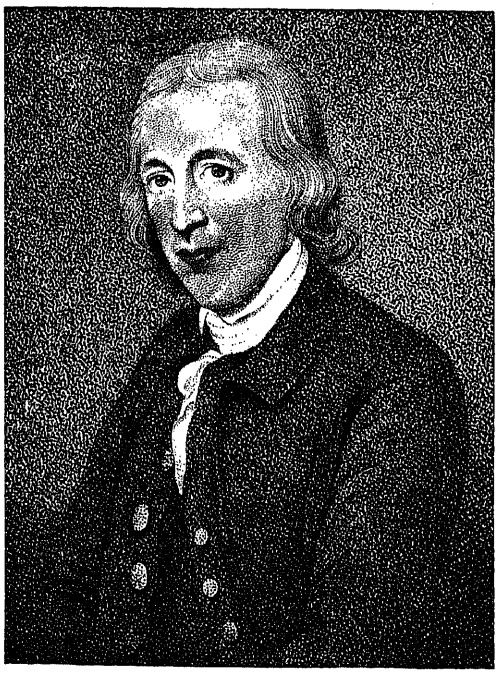
An Act of Congress, August 31, 1842, authorized the erection of a permanent Depot of Charts and Instruments for the navy at a cost of $25,000 or less. It was finished in 1844 and the books, charts, and instruments were removed to the new quarters. The Depot soon became known as the United States Naval Observatory. This was the early location of the Naval Observatory at 23rd and D Streets N.W. where the United States Naval Hospital now stands. The present location was selected in 1881.

The little observatory on Capitol Hill, spoken of in one place as a temporary shed having a modest transit instrument, passed out of existence in 1842. It had lasted about ten years. Here Lieutenant Wilkes and Lieutenant Gilliss had made literally thousands of excellent observations. It was rather a flimsy building. The story goes that severe storms often blew off the shutters and doors so that the instruments were exposed. But yet it was a regular astronomical observatory with the transit instrument permanently mounted and the observations were taken from inside through roof shutters. Of course it was used almost entirely for determining time and latitude and longitude.

The David Rittenhouse Observatories

The paternal ancestor of David Rittenhouse came from Arnheim on the Rhine. David, the eldest son of ten children, was

born in Roxborough, Philadelphia County, Pennsylvania, April 8, 1732. When two years old the family moved to Norriton, about 20 miles northwest of Philadelphia, and engaged in farming. When twelve years of age he received a bequest of tools and mathematical books from his uncle David and this seems to have turned him definitely towards mathematics, mechanics, and astronomy. In 1749, when seventeen years of age, he gained the reluctant consent of his father to abandon farming. He soon built a small shop on his father's land beside the public road and began his career as clock-maker. About 40 clocks of his manufacture are in existence and some of them are magnificent ones. He also made two famous orreries, surveying instruments, and astronomical instruments. He was a skilled surveyor and did some preliminary work with his own instruments for the Mason and Dixon line in 1763.

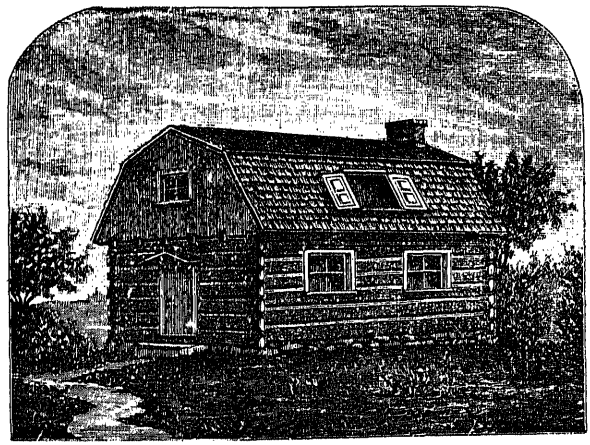


DAVID RITTENHOUSE
At the Age of 40

In 1770, David Rittenhouse moved to Philadelphia and lived at the southeast corner of Seventh and Arch Streets. He was elected Secretary of the American Philosophical Society in 1771, Vice President in 1790, and President in 1791. From 1779 to 1782 he was Professor of Astronomy and Vice Provost of the University of Pennsylvania. He was Treasurer of Pennsylvania from 1777 to 1789 and the first director of the United States Mint, 1792 to 1795. He died on June 26, 1796.

On June 3, 1769, occurred the famous transit of Venus. The

previous transit in 1761 had not been as favorable and was not as widely observed. The American Philosophical Society was then in existence and appointed a committee of thirteen to observe the rare occurrence. They were divided into three groups. One group under the leadership of Mr. Owen Biddle observed near the lighthouse at Cape Henlopen on Delaware Bay. Another group under the leadership of Dr. John Ewing observed in Philadelphia near the State House. The third and most important group, of which David Rittenhouse was a member, observed at Norriton. Each group erected a temporary observatory. The one in Philadelphia was said to have been an uncovered raised wooden platform. The observatory at Norriton, which is spoken of as a log-observatory, was commenced in November, 1768, and finished in April, 1769. The illustration of the observatory here given is not considered by everyone to be authentic. It can be argued that an observer of his skill would never have built an observatory so badly adapted to its purpose. A full account is given in Volume 7 of the *Transactions of the American Philosophical Society.* Extracts from the article are here reproduced. The observations were so excellent that combined with the observations at Greenwich a fairly accurate value of the solar parallax, and thus the distance of the sun, was determined.



THE LOG OBSERVATORY BUILT BY RITTENHOUSE IN NORRITON, PENN.
(From *Popular Astronomy*, Vol. IV, July, 1896)

An Account of the TRANSIT OF VENUS *over the* SUN's DISC, *as obſerved at* NORRITON, *in the County of* Philadelphia, *and Province of* Pennſylvania, June 3d, 1769.

By WILLIAM SMITH, *D. D. Provoſt of the College of* Philadelphia, JOHN LUKENS, *eſq; Surveyor-General of* Pennſylvania, DAVID RITTENHOUSE, *A. M. of* Norriton, *and* JOHN SELLERS, *Eſq; Repreſentative in Aſſembly, for* Cheſter *County*-----

Being the Committee *appointed for that Obſervation, by the* AMERICAN PHILOSOPHICAL SOCIETY, *held at* Philadelphia, *for promoting uſeful Knowledge.*

Communicated to the SOCIETY, July 20th, 1769, *by Direction, and in Behalf of, the* Committee; *by Dr.* SMITH.

GENTLEMEN,

AMONG the various public ſpirited deſigns, that have engaged the attention of this *Society*, ſince its firſt Inſtitution; none does them more honor than their early reſolution to appoint COMMITTEES, of their own Members, to take as many obſervations, in different places, of that *rare Phoenomenon*, the TRANSIT OF VENUS over the SUN's DISC, as they had any probability of being able to defray the expence of, either from their own funds, or the public aſſiſtance they expected.

As the members of the *Norriton-Committee* live at ſome diſtance from each other, I am, therefore, at their requeſt, now to digeſt and lay before you, in one view, the whole of our obſervations in that place; diſtinguiſhing, however, the part of each obſerver; and going back to the firſt preparations. For I am perſuaded that the dependence, which the learned world may place on any particular Tranſit-Account, will

will be in proportion to the previous and ſubſequent care, which is found to have been taken in a ſeries of accurate and well conducted obſervations, for aſcertaining the *going* of the time-pieces, and fixing the Latitude and Longitude of the places of obſervation, &c.

AND I am the more deſirous to be particular in theſe points, in order to do juſtice to Mr. *Rittenhouſe*, one of our Committee; to whoſe extraordinary ſkill and diligence is owing whatever advantage may be derived, in theſe reſpects, to our obſervation of the *Tranſit* itſelf. It is further preſumed, that aſtronomers, in diſtant countries, will be deſirous to have not only the work and reſults belonging to each particular *Tranſit-Obſervation*, but the materials alſo, that they may examine and conclude for themſelves. And this may be more particularly requiſite, in a New Obſervatory, ſuch as *Norriton*, the name of which hath perhaps never before been heard of by diſtant Aſtronomers; and therefore, its latitude and longitude are to be once fixed, from principles that may be ſatisfactory on the preſent, as well as on any future, occaſion.

OUR great diſcouragement, at our firſt appointment, was the want of proper apparatus, eſpecially good *Teleſcopes*, with *Micrometers*. the generoſity of our *Provincial Aſſembly* ſoon removed a great part of this diſcouragement, not only by their vote to purchaſe one of the beſt Reflecting Teleſcopes, with a *Dollond's* Micrometer; but likewiſe by their ſubſequent donation of *One Hundred Pounds*, for erecting Obſervatories, and defraying other incidental expences. It was foreſeen that on the arrival of this Teleſcope, added to ſuch private ones as might be procured in the city, together with fitting up the inſtruments belonging to the Honorable the Proprietaries of the Province, *viz.* the *equal Altitude* and *Tranſit Inſtrument*, and the large aſtronomical *Sector*, nothing would be wanting for the *City-Obſervatory* in the State-Houſe Square, but a good Time-Piece, which was eaſily to be procured.

WE remained however ſtill at a loſs, how to furniſh the *Norriton Obſervatory*. But even this difficulty gradually vaniſhed.

Early

Early in *September*, 1768, ſoon after the nomination of our *Committees*, I received a letter from that worthy and honorable Gentleman, THOMAS PENN, Eſq; one of the Proprietaries of this Province, which he wrote at the deſire of the Rev. Mr. *Maſkelyne*, Aſtronomer Royal, expreſſing their deſire, "That " we would exert ourſelves in obſerving the Tranſit, for " which our ſituation would be ſo favourable"; and enclo-ſing ſome copies of Mr. *Maſkylyne's* printed directions for that purpoſe.

THIS gave me an opportunity, which I immediately em-braced, of acquainting Mr. PENN what preparations we had already made; and what encouragement the Aſſembly had given in voting *One Hundred Pounds* Sterling, for the purchaſe of One Reflecting Teleſcope and Micrometer, for the City Obſervatory; but that we ſhould be at a great loſs for a tele-ſcope of the like conſtruction for the *Norriton-Obſervatory*, and requeſting him to order a *Reflector* of two, or two and an half feet, with *Dollond's* Micrometer, to be got ready as ſoon as poſſible in *London*. It was not long before I had the pleaſure to hear that Mr. PENN had ordered ſuch a Teleſcope, which came to hand about the middle of *May*, with a moſt obliging letter, expreſſing the ſatisfaction he had in hearing of the ſpirit ſhewn at *Philadelphia*, for obſerving this curious Phoenomenon when it ſhould happen; and concluding as follows---

"I HAVE ſent, by Capt. *Sparks*, a Reflecting-Teleſcope with " *Dollond's* Micrometer, exact to your requeſt, which I hope " will come ſafe to hand. After making your obſervation " with it, I deſire you will preſent it, in my name, to the Col-" lege---Meſſrs. *Maſon* and *Dixon* tell me, they never uſed a " better than that* which I formerly ſent to the Library Com-

* Mr. OWEN BIDDLE, who was appointed by the Society to conduct the ob-ſervation near *Cape Henlopen*, had this teleſcope; nothing being deſired there but the *contacts* and their exact time; which he obtained to great ſatisfaction, as by his report may appear. As he had but ſhort time to prepare, and there was a difficulty in getting the neceſſary apparatus for fixing, by his own obſervations, the longitude and latitude of the place choſen for his ſtation, it was reſolved to depend on the aſcertaining theſe articles, by running a line from the place of his obſervation to a known point in the work of Meſſrs. *Maſon* and *Dixon*, when employed in ſettling the boundary lines of *Pennſylvania* and *Maryland*; and in meaſuring a degree of latitude, along that fine level peninſula, between *Delaware* and *Cheaſopeake* Bays.

" pany

" pany of *Philadelphia*, with which a good obſervation may " be made, tho' it has no micrometer."

WE were now enabled to furniſh the *Norriton* Obſervatory, as follows, *viz.*

1. A GREGORIAN REFLECTOR about 2 f. focal length, with a *Dollond's* Micrometer. This Teleſcope hath four different magnifying powers, viz. 55; 95, 130, and 200 times; by means of two Tubes containing eye-glaſſes that magnify differently, and two ſmall speculums of different focal diſtances. Made by *Nairne*. Uſed by Dr. SMITH.

2. A REFRACTOR of 42 f. its magnifying power about 140. The glaſſes were ſent from *London* with the large Reflector, and belonged to *Harvard* College, *New England*; but as they did not arrive time enough to be ſent to that place before the Tranſit, they were fitted up here, by Mr. *Rittenhouſe*; and---- Uſed by Mr. LUKENS.

3. MR. *Rittenhouſe's* REFRACTOR, with an object glaſs of 36 f. focus, and a convex eye-glaſs of 3 inches, magnifying about 144 times. Uſed by HIMSELF.

BOTH theſe Refractors, as well as the Reflector, were in moſt exquiſite order.

4. AN *Equal-Altitude Inſtrument*; its teleſcope three and an half f. focal length, with two horizontal hairs, and a vertical one, in its focus, firmly ſupported on a ſtone pedeſtal, and eaſily adjuſted to a plummet wire 4 feet in length, by 2 ſcrews; one moving it in a North and South, the other in an Eaſt and Weſt, direction.

5. A TRANSIT-TELESCOPE, fixed in the *Meridian* on an axis with fine ſteel points; ſo that the hair in its focus can move in no other direction than along the meridian; in which are two marks South and North, about 330 yards diſtance each; to which it can be readily adjuſted in a horizontal poſition by one ſcrew, as it can in a vertical poſition by another ſcrew.

6. AN

6. AN excellent TIME-PIECE, having for its pendulum-rod a flat ſteel-bar, with a *bob* weighing about 12 lb. and vibrating in a ſmall arch. It goes 8 days, does not ſtop when wound up, beats dead ſeconds, and is kept in motion by a weight of 5 pounds.

THESE three laſt articles were alſo Mr. *Rittenhouſe*,s property, and made by himſelf.

7. AN ASTRONOMICAL QUADRANT, two and an half f. radius, made by *Siſſon*, the property of the *East-Jerſey* Proprietors; under the care of the Right Hon. *William* Earl of *Stirling*, Surveyor-General of that Province; from whom Mr. *Lukens* procured the uſe of it, and ſent it up to Mr. *Rittenhouſe* for aſcertaining the latitude of the Obſervatory. Thus we were at length compleatly furniſhed with every inſtrument proper for our work.

As Mr. *Rittenhouſe*'s dwelling at *Norriton* is about 20 miles North-Weſt of *Philadelphia*, our other engagements did not permit Mr. *Lukens* or myſelf, to pay much attention to the neceſſary preparations; but we knew that we had entruſted them to a gentleman on the ſpot, who had joined to a compleat ſkill in *Mechanics*, ſo extenſive an *aſtronomical* and *mathematical* knowledge, that the uſe, management, and even the conſtruction, of the neceſſary apparatus, were perfectly familiar to him. Mr. *Lukens* and myſelf could not ſet out for his houſe till *Thurſday*, *June* 1ſt; but, on our arrival there, we found every preparation ſo forward, that we had little to do, but to examine, and adjuſt our reſpective teleſcopes, to diſtinct viſion. He had fitted up the different inſtruments, and made a great number of obſervations, to aſcertain the going of his Time-Piece, and to determine the latitude and longitude of his *Obſervatory*. The laudable pains he hath taken in theſe material articles, will beſt appear from the work itſelf, which he hath committed into my hands, with the following modeſt introduction; giving me a liberty, which his own accuracy, care and abilities, leave no room to exerciſe.

Nor-

Norriton, July 18, 1769.

DEAR SIR,

" THE *incloſed is the beſt account I can give of the* CON-
" TACTS, *as I obſerved them; and of what I ſaw during*
" *the interval between them. I ſhould be glad you would contract*
" *them, and alſo the other papers, into a ſmaller compaſs, as I*
" *would have done myſelf, if I had known how. I beg you would*
" *not copy any thing merely becauſe I have written it, but leave out*
" *what you think ſuperfluous.*

I am,

With great esteem and affection,

Yours, &c.

DAVID RITTENHOUSE."

To Revd. Dr. SMITH.

Mr. RITTENHOUSE's *Obſervations at* Norriton, *before and after the* TRANSIT OF VENUS, June 3d, 1769; *for fixing the Latitude and Longitude of his Obſervatory, and the going of his Clock,* &c.

" EARLY in *November,* 1768, I began to erect an
" *Obſervatory,* agreeable to the reſolutions of the AME-
" RICAN PHILOSOPHICAL SOCIETY; but, thro' various diſap-
" pointments from workmen and weather, could not com-
" pleat it, till the middle of *April,* 1769. I had for ſome
" time expected the uſe of an *Equal Altitude* inſtrument
" from *Philadelphia*; but finding I could not depend on
" having it, I fell to work, and made one of as * ſimple a
" conſtruction as I could. *March* 20th this inſtrument was
" finiſhed, and put up out of doors, the Obſervatory not
" being yet ready.

**It is deſcribed above, No.* 4, *of the Apparatus.*

" I HAD, however, for ſome weeks before this, with my " 36 f. Refractor, obſerved eclipſes of Jupiter's ſatellites, in " ſuch a manner that, tho' my equal-altitude inſtrument was " not finiſhed, and conſequently I could not ſet my time- " piece to the true noon, I ſhould nevertheleſs be able to tell " the time of thoſe eclipſes afterwards, when the inſtrument " ſhould be ready. For this purpoſe, I obſerved, almoſt eve- " ry fair evening, the time by the clock, when the bright ſtar " in Orion diſappeared behind a fixed obſtacle, by applying " my eye to a ſmall ſight-hole, made thro' a piece of braſs, " faſtened to a ſtrong poſt.

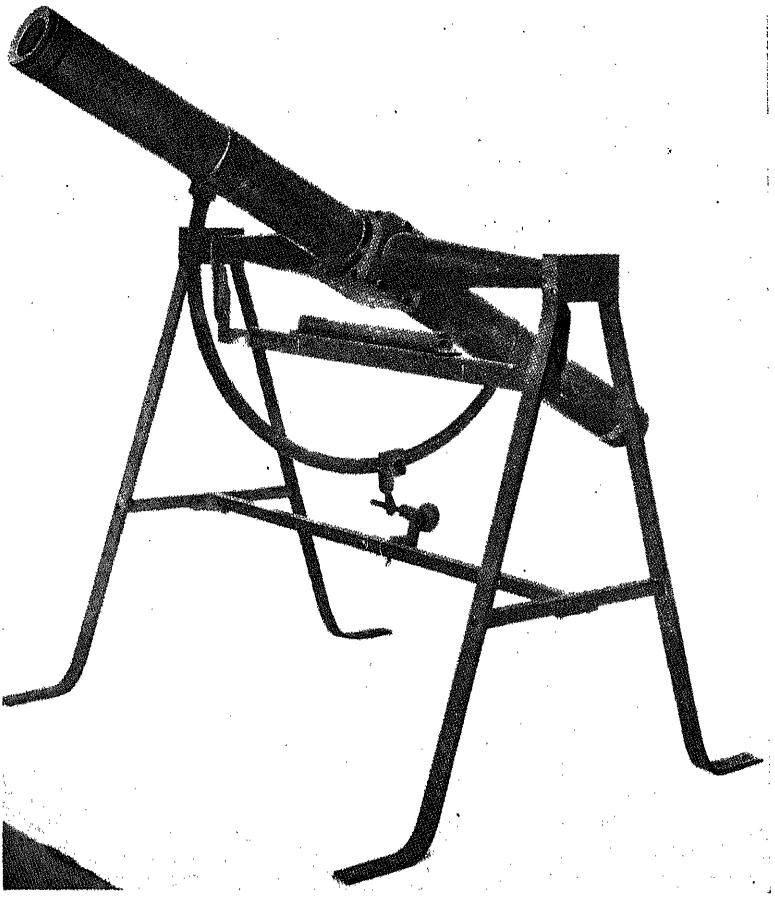
In 1770, Rittenhouse moved to Philadelphia and the Norriton Observatory was soon after dismantled. It thus lasted but three or four years and was clearly only a temporary observatory erected for practically one purpose, namely to observe the transit of Venus. Rittenhouse located on the southeast corner of Seventh and Arch Streets in Philadelphia. On the northwest corner, diagonally opposite, he eventually erected a small but convenient octagonal brick observatory. This was before 1786, since in that year he constructed his new residence near the observatory which he occupied for the rest of his life. In this observatory some of his instruments were installed and he made general observations which were published. The building of this observatory was partly financed by a grant from the Assembly. At first he used a 1,200 foot meridian mark with the transit instrument. After a time other buildings gradually surrounded the observatory so that the meridian mark could not be observed. To obviate this difficulty he invented the use of a collimating telescope. When Rittenhouse died in 1796 he was buried under his observatory.

On June 27, 1796, Moreau de Saint Mery writes:

> Yesterday I attended the funeral rites here of the celebrated Dr. Rittenhouse, American astronomer whose loss his country most justly mourns. He was buried in the floor of the Observatory which he had had constructed in his own Garden. What a philosophic union, perishable ashes with an edifice consecrated to the observation of the most sublime marvels of nature! What a raprochement between the genius of man and his nothingness!

Later his body was removed to old Pine Street and at present his remains rest in North Laurel Hill Cemetery.

This observatory, which had lasted more than ten years, was no longer used and was eventually dismantled.

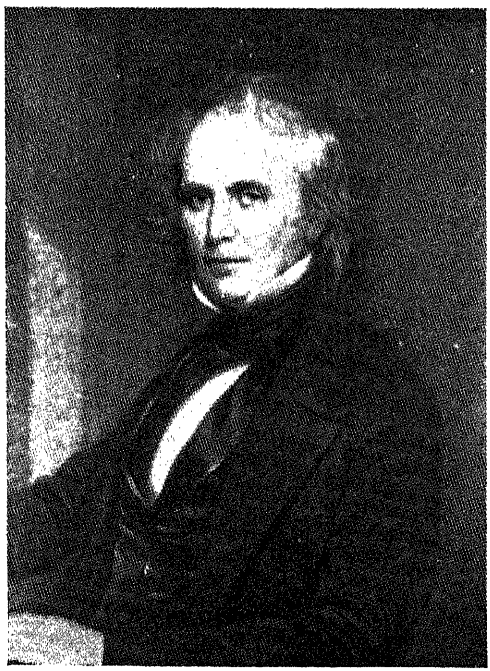


TRANSIT INSTRUMENT MADE BY DAVID RITTENHOUSE AND USED BY HIM WHILE OBSERVING THE TRANSIT OF VENUS, JUNE 3, 1769
Owned by the American Philosophical Society
(*From the Pennsylvania Magazine of History and Biography*, July, 1932)

William Cranch Bond's Observatory — The Harvard College Observatory

William Cranch Bond was born in Falmouth, now Portland, Maine, on September 9, 1789. His father, William Bond, was engaged in the export of lumber but this did not prove successful so he moved to Boston and returned to his trades of silversmith and clock-maker at the corner of Milk and Washington Streets.

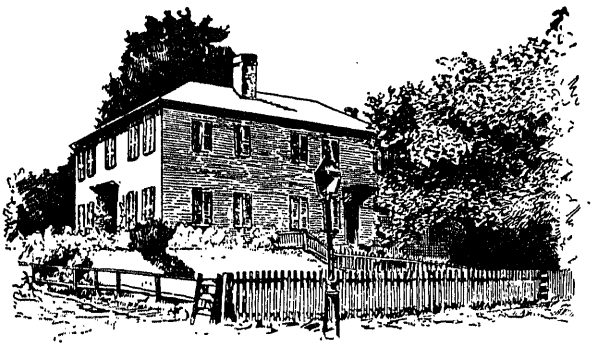
Young William was obliged to leave the public school early to help earn the family living by working with his father. It is related of him that at the age of ten he made a crude clock with wooden works. At the age of fifteen he made a chronometer driven by a weight which was reasonably accurate. For a number of years before 1812 the errors and rates of nearly all of the chronometers of the ships out of the port of Boston were determined by him. In 1812, when twenty-three years of age, he made what was perhaps the first regular chronometer made in America. Chronometers could not then, on account of the war, be procured from England. This chronometer was thoroughly tested by a voyage to Sumatra and return in the ship *Cyrus*, commanded by Captain Thomas B. Curtiss. It is still in existence and in the possession of the Bond family.



WILLIAM CRANCH BOND
1789-1859

The first transit instrument used at Dorchester was a strip of brass nailed to the east end of the Champney house, with a hole in it to see a fixed star and note its transit. This was in 1813. Previous to this, time for rating the chronometers had been determined by sextant observations. Bond was married July 18, 1819, and a few years later he purchased a house near his father's residence in Dorchester. In connection with it he erected a small wooden building and equipped it with astronomical and meteorological instruments. The only parlor in the house at Dorchester was sacrificed to science — a huge granite block rose

in the middle of the room and the ceiling was intersected by an opening in the meridian. Such was Bond's Dorchester Observatory. Here he did constant work on the rates of chronometers and he made meteorological and magnetic observations as well. He was a constant observer of the heavens for the sheer love of it. Even his children were pressed into service as observers and recorders. And all the while he was earning his living by making, repairing, and rating chronometers and watches.



THE BOND HOUSE, DORCHESTER, MASS.
View looking to the Southwest
The Observatory stood contiguous to the West end

The Nantucket Maria Mitchell Association in its *Annual Report*, under Chronological Record in the Life of Maria Mitchell, publishes this:

1831. In observing the annular eclipse of the sun, Maria Mitchell was her father's assistant. "These observations, made in connection with those of Paine at Monomoy and Bond at Dorchester, had for practical object the determination of the longitude of the house in Vestal Street, where the chronometers of the whale ships were rated and set to Greenwich time."

In 1838 when Captain Wilkes took charge of the exploring expedition to the South Seas, William Cranch Bond made observations under an appointment and contract with the Government of the United States of the moon culminating stars, of occultations of stars by the moon and of other celestial phenomena for the better determination of his longitude. He was then spoken of as a skillful, accurate, and attentive observer. Bond immediately erected a new observatory of ample size in Dor-

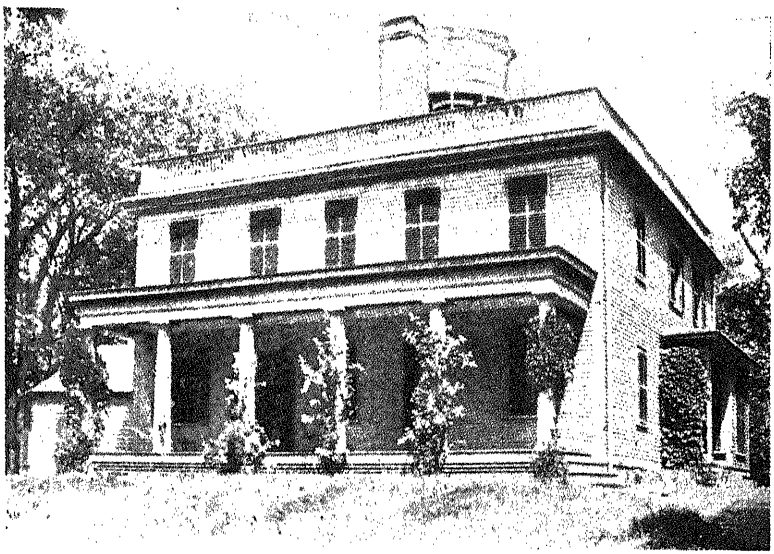
chester. Here, and later at Dana House, he observed from 1838 to 1842.

Professor Rufus in his article on "Astronomical Observatories in the United States prior to 1848," in Volume XIX of the *Scientific Monthly*, defines an early astronomical observatory as a tube with an eye at one end and a star at the other. If one accepts this fanciful definition of an observatory then Harvard College possessed a very early observatory. John Winthrop, who was born December 19, 1714, was made Hollis Professor of Mathematics and Natural History in 1738. In 1739 he made observations of sun spots which were published. On April 27, 1740, he observed a transit of Mercury. In 1761 he went to Newfoundland to observe a transit of Venus in a sloop owned by the Province of Massachusetts. In 1769 he observed the transit of Venus at Cambridge. In this instance, so the story goes, rather slow-going Philadelphia got the better of Cambridge. Professor Winthrop was to have a new telescope to observe the transit. It was shipped on a vessel going to Philadelphia and arrived only a short time before the transit. Knowing that it could not reach Boston in time, it was unpacked and used in Philadelphia and then sent on to Boston. In 1780 an expedition to observe a total eclipse of the sun was sent to Penobscot Bay. A more correct statement would thus be that Harvard College possessed astronomical instruments from an early date but no astronomical observatory.

As early as 1805 we find Mr. John Lowell, at that time residing in Paris, consulting with the celebrated French astronomer, Delambre, on the subject of astronomical observatories and procuring from him written instructions in regard to suitable instruments and buildings. Apparently the building of an observatory was already receiving serious consideration but nothing came of it.

May 10, 1815, at a meeting of the President and Fellows of Harvard University, it was voted that the President, Treasurer, and Mr. Lowell, with Professor Farrar and Mr. Bowditch, be a committee to consider upon the subject of an observatory and report to the Corporation their opinion upon the most eligible plan for the same and the site. Mr. William C. Bond was just departing for Europe and he was instructed by Professor John Farrar to pay particular attention to the construction of the

Greenwich Observatory and the instruments. Other observatories in England were also visited and a full report was made the following year. It was found to be too expensive and nothing came of



DANA HOUSE
The first Observatory of Harvard College

it. The subject was brought up again in 1822 but no progress was made. The Harvard Observatory was finally established by an official act of the Corporation of Harvard University in October, 1839. Harvard officials raised $3,000 to adapt Dana House as an observatory. Bond was persuaded to become the first director without salary and he added his instruments to those owned by the college. The last Dorchester observation was made on the 25th, December, 1839, and the first Cambridge observation was made December 31, 1839. Josiah Quincy, President of Harvard University, in his *History of Harvard University*, published in 1840, enumerates the available instruments:

> The observatory has now at its command, from the college apparatus and the instruments belonging to Mr. Bond, a transit instrument and variation transit, by Troughton and Symms; an astronomical clock, one refracting and two reflecting telescopes; an astronomical quadrant by Bird; Gauss' magnetometer; a small transit by Bird; a quadrant and sextant, with chronometers,

thermometers, barometers, hygrometers, dipping and variation needles. To render the observatory as efficient as could be desired, there is wanted a refracting telescope equatorially mounted, a mural circle, and a large transit instrument.

Dana House was a large and substantial building situated on the southeast corner of the college grounds, having Harvard Street on the south and Quincy Street on the east. Although changed to become an observatory, it was also to be the residence of the Bond family. A cupola with a turning roof was erected on the top of the house. A large reflector belonging to the college and made by Short of London was mounted here. The transit instrument was placed in a building near by. One room of the house contained the clocks, chronometers, standard barometer, and other apparatus. Another building contained the magnetic instruments. Dana House continued to be the Observatory of Harvard University for about four years when the present location was chosen. William Cranch Bond continued to be director of the Observatory of Harvard University until his death on January 29, 1859.

The Observatory of the College of William and Mary

The College of William and Mary apparently possessed an astronomical observatory at a very early date, at least prior to 1789. In Volume 3, page 150, of the *Transactions of the American Philosophical Society* occurs the following:

Astronomical Observations, communicated by David Rittenhouse

Observations of a lunar eclipse Nov. 2d, 1789, and of the transit of Mercury over the sun's disk. Nov. 5th the same year, made at the University of William and Mary, by the Rev'd Dr. James Madison.

* * * * *

(Read Feb. 4th. 1791)

As the observatory in which the transit instrument had been formerly placed, was not, at this time, rebuilt, I was not enabled to attend to the going of the time-keeper, by means of such observations as I wished to have made. I therefore had recourse to correspondent double altitudes, taken with a sextant.

It is supposed that Bishop Madison had very good scientific equipment for the time until the Yorktown campaign of 1781. The British soldiers at first occupied some of the college build-

ings and later, the French soldiers. It may have been then that the observatory was destroyed. It probably contained nothing but a transit instrument and a clock.

Dr. James Madison was born August 27, 1749, near Staunton, Virginia. He was graduated from the College of William and Mary in 1771 and in 1773 he was made Professor of Natural Philosophy and Mathematics. In 1777 he was made President and continued in office until his death on March 6, 1812. He was a man of strong scientific inclinations and was spoken of as a man of note among the scientific men of his day. He was also a surveyor and thoroughly familiar with astronomical instruments. A few extracts from old letters will illustrate this.

BISHOP JAMES MADISON
1749-1812

From a letter dated July 26, 1778, telling of a solar eclipse: "I had the time very accurate."

From a letter dated 1780: "Our longitude may be seen from the following observations this summer . . . . The observations were made with a Reflector by Short, magnifying 200 — Time obtained by = altitudes. We have an excellent Time Keeper."

From a letter dated December 2, 1783 by J. Madison, Robert Andrews, and John Page to Governor Benjamin Harrison in regard to surveying the Virginia-Pennsylvania boundary:

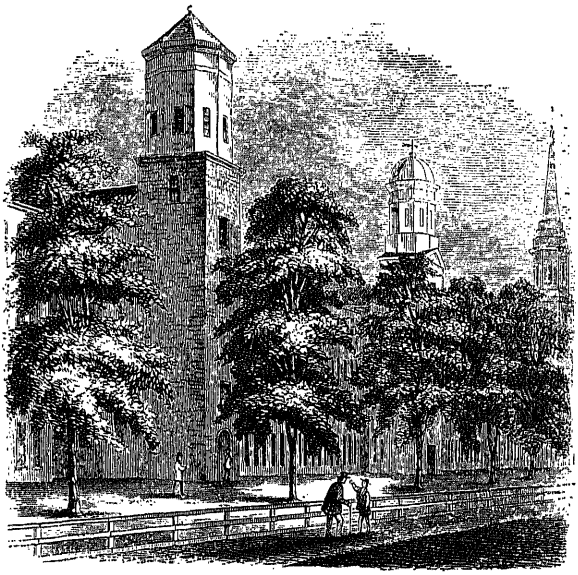
> We have considered the Instruments which will be necessary for us in fixing the Boundary of Virginia & Pennsylvania, & find so great a Deficiency in this state that unless Instruments of the Value of about £135 Sterling can be procured which we think will most easily be done by Importation, the Business can not be accomplished with any Degree of Accuracy. The Observatories, which must be built at each Extremity of the Line, will, we suppose cost one hundred Pounds currency . . . .

From a letter dated April 10, 1785:

We were engaged last year in determining the 5 Degrees of Longitude claimed by Pennsa. and I believe few points in the globe are better ascertained. Our instruments were good. The timepiece I carried from this place exceeded even Mr. Rittenhouse's.

Yale Observatory

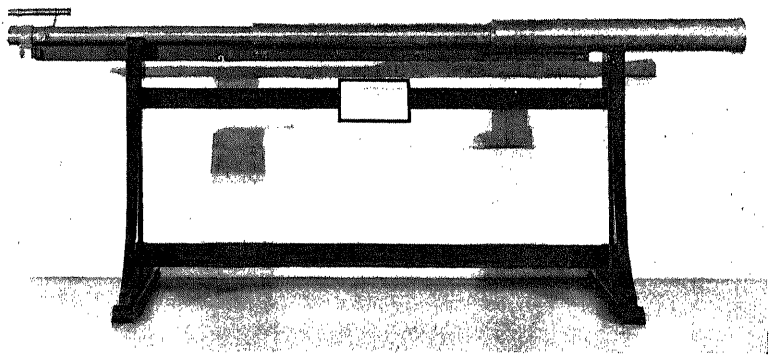
In 1828 Mr. Sheldon Clark donated the sum of $1,200 to Yale University for the purchase of a telescope. It was procured from Dollond of London and arrived in 1830. It was five inches in



YALE COLLEGE OBSERVATORY IN THE ATHENAEUM TOWER
(From *Harper's New Monthly Magazine*, June, 1856)

diameter, had a focal length of 10 feet, and was provided with a spider line micrometer. This instrument was much larger than any telescope then in the country. It was declared by the maker to be "perfect and such an instrument as he was pleased to send as a specimen of his powers." The telescope had an altitude and azimuth mounting and was placed in the Athenaeum Tower. It was mounted on casters and pushed about from one window to another. The windows were low and no object more

than 30 degrees above the horizon could be observed. At the hands of Professor Denison Olmsted and Elias Loomis it was, however, put to good use. In 1835 Halley's comet was observed before news of its rediscovery reached America. The teaching power of Professor Olmsted, the Dollond telescope, the meteor shower in 1833, and Halley's comet in 1835 aroused much astronomical enthusiasm at Yale. Professor Elias Loomis in his article on "American Observatories in the United States" in *Harper's New Monthly Magazine* for June, 1856, says: "A transit



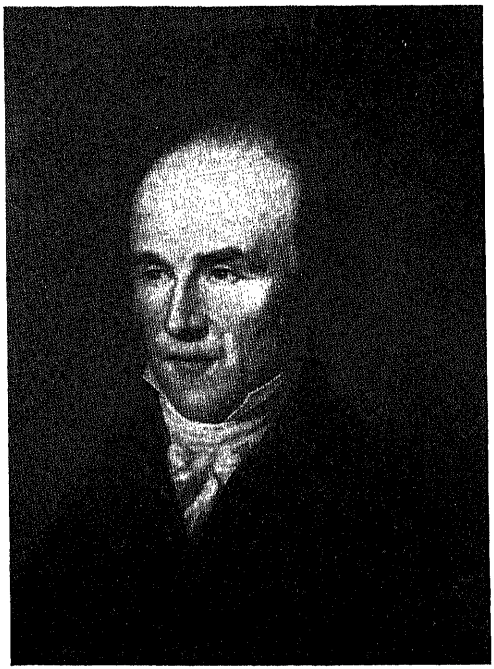
THE FIVE INCH YALE TELESCOPE NOW ON EXHIBIT AT THE FRANKLIN INSTITUTE IN PHILADELPHIA
(From a photo by Gladys Muller)

instrument of five feet focal length and four inches aperture has recently been presented to Yale College by Mr. William Hillhouse of New Haven; but for want of a suitable building for its reception this instrument has not yet been mounted." The Clark telescope thus seems to have been the only instrument in use for a long time. In fact it remained in the Athenaeum Tower for more than thirty years. It is now on exhibit at the Franklin Institute in Philadelphia.

The Observatory of the University of North Carolina

Joseph Caldwell was born in Lamington, N.J., on April 21, 1773. He was a Princeton graduate in the class of 1791 when only 18 years of age and in 1795 was made tutor in mathematics at Princeton. In 1796 he was called to the University of North

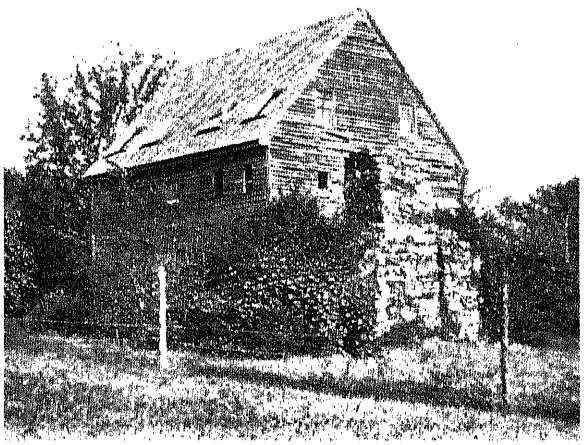
Carolina as professor. The University had then been opened but one year. In 1804 he was elected President and continued in office until his death on January 27, 1835.



JOSEPH CALDWELL
1773-1835

In 1824, when the institution was in somewhat better financial condition, President Caldwell was given $6,000 by the trustees and went to Europe to purchase books and scientific apparatus. Having always been fond of the science of astronomy he spent quite a large part of this sum for astronomical instruments. These were: a meridian transit telescope made by Simms, of London; an altitude and azimuth telescope also made by Simms; a telescope for observation on the earth and sky, made by Dollond, of London; and an astronomical clock with a mercurial pendulum, made by Molineux, of London. To these stationary instruments were added: a sextant, made by Wilkinson, of London; a portable reflecting circle, made by Harris, of London; and a Hadley's quadrant. Of these the altitude and azimuth telescope was particularly fine. The horizontal and vertical circles were twenty and twenty-four inches in diameter, respectively. Two verniers and reading microscopes were provided for each circle and they were graduated to five minutes of arc on platinum bands. These instruments were stored in the University buildings and used in the open or on the roof of the President's house until 1831. It is said that a platform had been placed on the roof of the

President's house chiefly for naked-eye observations and for instruction. An observatory was erected largely at President Caldwell's expense in 1830 and 1831. Its cost was $430.29½, and it was placed on the highest summit of a hill north of the Raleigh road near the village graveyard. It was of brick and stone construction, about 20 feet square and 25 feet high (15 by 23 according to one account), without portico or entry hall. A well-constructed pier furnished a stable foundation for the transit instrument. The flat roof contained a wide slit which

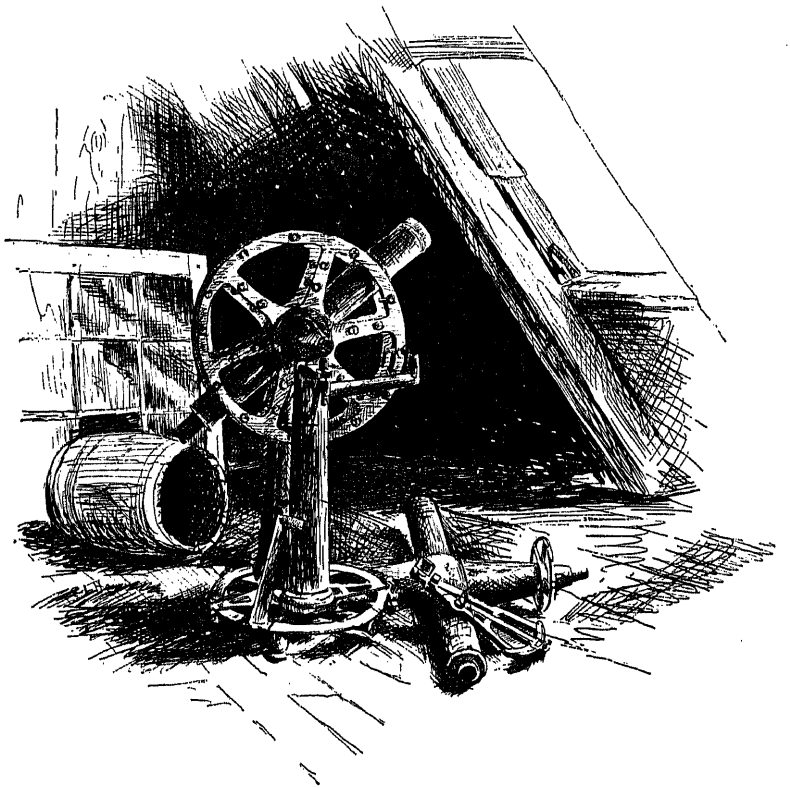


PROFESSOR MITCHELL'S LABORATORY AND OBSERVATORY
(From *Popular Science Monthly*, October, 1896)

continued for some distance down the walls and afforded a range of 120° for the transit instrument.

Another pier rose through the roof and was capped with a circular disc of sandstone. On this was placed the altazimuth instrument. It is said that it was covered with a wooden cover which could be drawn aside when it was in use. Professor Caldwell was assisted in his observations by Professors Elisha Mitchell and James Phillips, and their first work was to find the approximate value of the longitude and latitude of the building in which they worked. The roof soon gave trouble and leaked so badly that even before the death of President Caldwell in 1835 the instruments had to be removed. After his death the building

went rapidly to decay. It was partially burned in 1838. The fire is said to have been set by some students. Later, the bricks which were good were appropriated by President Swain, Cald-



THE OLD INSTRUMENTS AS AT PRESENT
(From *Popular Science Monthly*, October, 1896)

well's successor, to build a kitchen. After 1838 observations were, however, continued by Dr. Elisha Mitchell in the attic of the large wooden building which he used as a chemical and metallurgical laboratory. In each end of the attic were two large windows, and in the roof eight others, four on either side. These observations were continued until the summer of 1857.

Eventually the instruments were permanently laid aside. It is said that Sherman's soldiers found that the tube of the old telescope on a dusty shelf had been selected by some of the pro-

fessors as the safest hiding place for their watches and other valuable possessions. They underestimated the keen-eyed seekers for hidden valuables, for they were discovered. According to the story, however, the commanding officer was in love with the President's daughter and forced the lucky soldiers to return their find.

A somewhat different version of the building of the observatory is given by Collier Cobb in *Popular Science Monthly*, October, 1896, pp. 763-771:

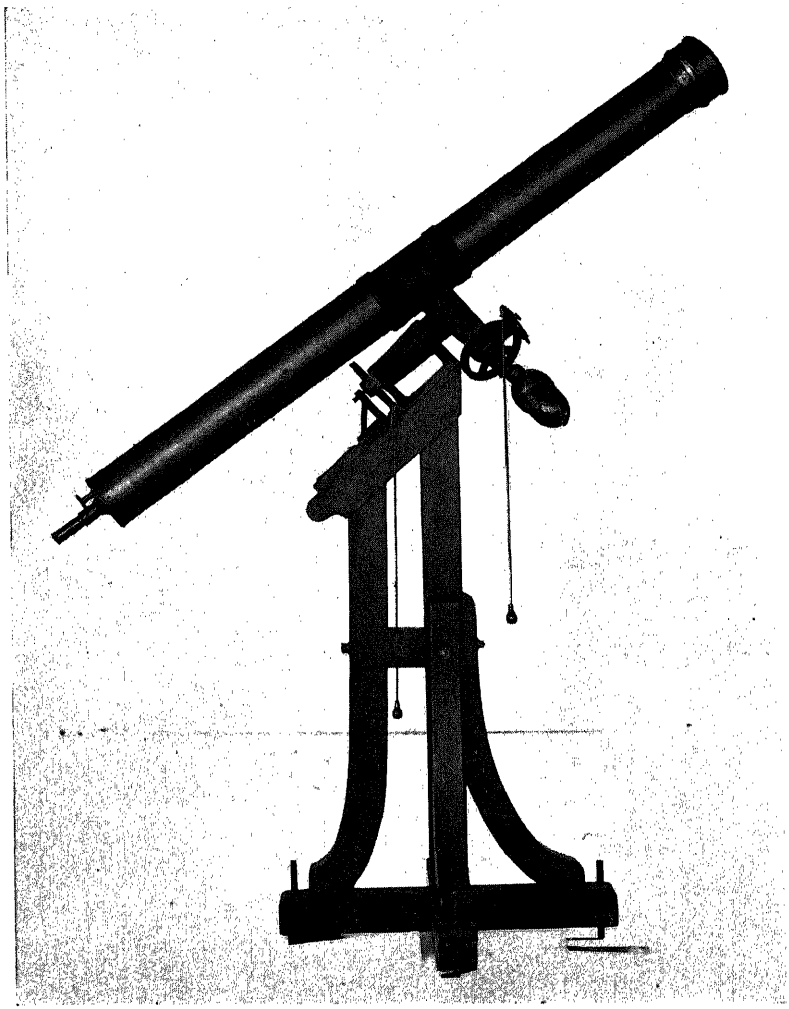
> Before the completion of the observatory building the clock and meridian transit were set up and used in the library of the University which was also Prof. Caldwell's lecture room. Here began in 1825 the first systematic observations upon the heavens made in the United States.

THE FIRST OBSERVATORY ACCORDING TO COBB
(From *Popular Science Monthly*, October, 1896)

According to Mr. Cobb the observatory was finished in 1827 and in this observatory were placed the instruments procured in Europe. A picture of the observatory which accompanies the article is here reproduced.

The meridian transit could hardly have been set up and used in President Caldwell's lecture room. Roof slits and slits in the walls facing the north and south would have been necessary and that would have required the reconstruction of the whole room. Presumably this was simply a repository for the apparatus which was used in the open. The building pictured has a steep roof and no slits of any kind. It could hardly have been an observa-

tory. Perhaps this was the library and lecture room which has been mentioned. A building corresponding to the description of the observatory would have had an entirely different appearance.

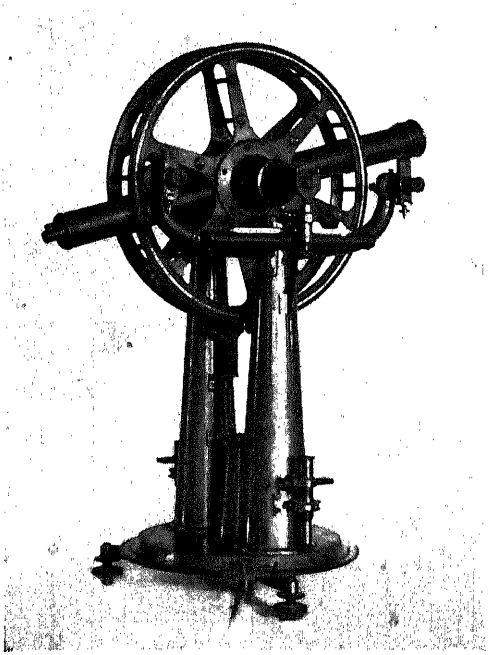


THE 6 INCH REFRACTOR BY LEREBOURS
WESLEYAN UNIVERSITY, MIDDLETOWN, CONN.
(From a photograph by Professor Frederick Slocum)

The Wesleyan Observatory

Carl F. Price in his book, *Wesleyan's First Century*, published by Wesleyan University, Middletown, Connecticut, in 1932, has this to say about the first observatory on page 40:

In 1838-39 a small octagonal white wooden building was erected as an astronomical observatory on Cross Street in the rear of Professor A. W. Smith's house (later Professor Rice's). It was nine feet in diameter. In 1854 it was moved to the spot where the southwest corner of Rich Hall stood in 1868, when it had a somewhat ignominious fate for so important a window to the nightly heavens: a certain Mr. Tuit thereafter removed it to Indian Hill and used it as a hen-house (from Astronomy to Poultry!).



THE UNIVERSAL INSTRUMENT PURCHASED IN 1836
WESLEYAN UNIVERSITY, MIDDLETOWN, CONN.
(From a photograph by Professor Frederick Slocum)

The second observatory was built in 1868 to house the Alvan Clark 12 inch refractor. It was cylindrical in shape and mounted on a tower attached to one of the dormitories and called Observatory Hall.

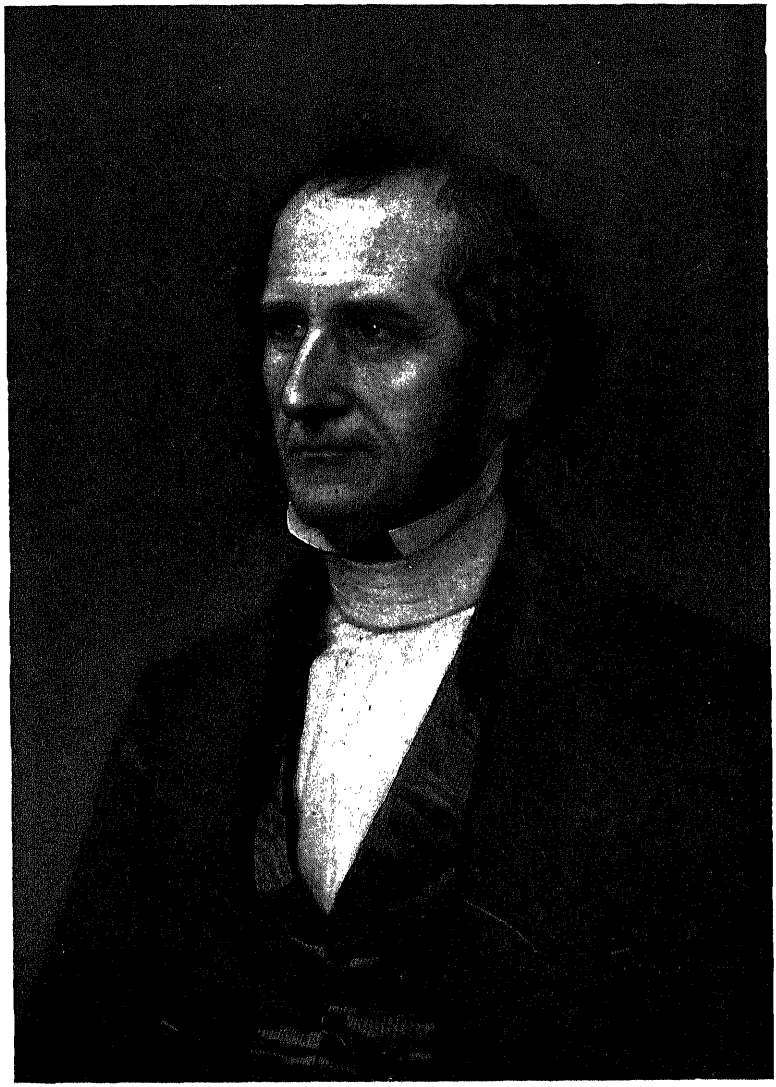
The fine Van Vleck Observatory is the third and present one. It was commenced in 1914, used for classes in 1915, and dedicated at commencement, 1916.

Wesleyan was founded in 1831 and the first president, Willbur Fisk, was in Europe during the academic year 1835-36 to procure philosophical apparatus. A 6 inch refractor by Lerebours, of Paris, was purchased in the early part of 1836. This was tested by Arago at the Paris Observatory and his certificate of test is dated April 28, 1836. There is no certain record as to where and when it was set up. Some claim that the first observatory dates from 1836 instead of 1838. This first observatory was also equipped with a Molyneux clock and a universal or altitude azimuth instrument, both bought in 1836. The vertical circle is 17½ inches in diameter, the horizontal circle 15 inches, and the aperture is 2¼ inches and the focal length 27 inches. Engraved on the horizontal plate is "Troughton and Simms, London, 1836." All three of these instruments are still in the possession of Wesleyan University.

The Hopkins Observatory of Williams College

In 1828 Albert Hopkins came to Williams College as tutor and in 1829 he was made Professor of Mathematics and Natural Philosophy. He was the youngest of the three children of Archibald and Mary Curtis Hopkins, and was born in Stockbridge, Massachusetts, on July 14, 1807. His early boyhood was spent on his father's farm and in attending the district school. His later education was at the Stockbridge Academy, and from there he entered the sophomore class at Williams College in 1824. He was graduated with the class of 1826 when only 19 years of age, and at commencement delivered the Philosophical Oration entitled "Caloric." After graduation young Hopkins did surveying for a while and considered entering the ministry. In 1828 he was invited to become a tutor in the college, and in 1829 he was made professor, and held this position forty-three years, until his death on May 24, 1872. He was a brother of Mark Hopkins who was president of Williams College from 1836 to 1872.

In June, 1834, it was decided that Albert Hopkins should visit Europe to study the methods of scientific instruction and to secure apparatus for this instruction. The minutes of the Board



ALBERT HOPKINS, 1807-1872

of Trustees for August, 1834, contain this "Report of Standing Committee":

. . . . the sum of four thousand dollars has been raised by subscription by the Alumni of the college and other liberal patrons of the institution, to be applied to the purchase of Philosophical and Chemical apparatus for the use of the institution and that it will be necessary to send an Agent to Europe to purchase the same, recommended to the Board that Professor Albert Hopkins have permission to be absent for that purpose from the 1st day of September next to the first day of May following and that during that time he be allowed his salary as usual he paying all his expenses during his absence.

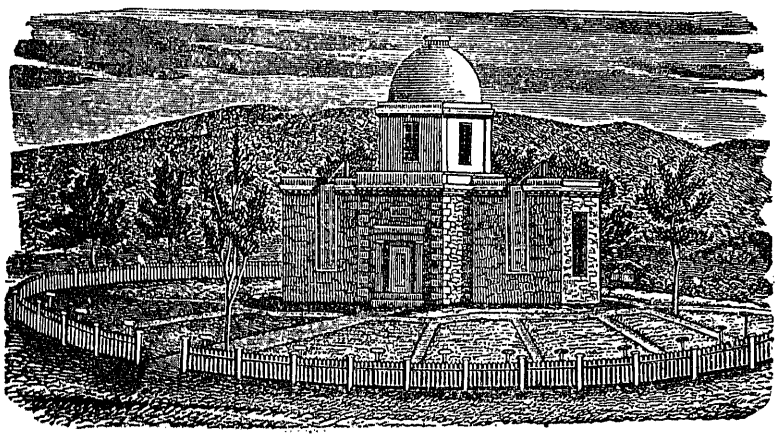
He sailed in September on the packet-ship *Hibernia* for Liverpool and returned the following May. He brought with him quite a little apparatus, particularly astronomical equipment. It is likely that the older sidereal clock, the Troughton and Simms* transit instrument and the Herschelian reflector of ten feet focus were purchased at this time. These were not, however, the first astronomical instruments to be possessed by Williams College. The minutes of the Trustees for September 1, 1802, contain this: ". . . to procure a telescope for the college apparatus." This was presumably a small portable telescope to be used in the open for gazing purposes.

The next thing was to have a real astronomical observatory. In the autumn of 1836 the quarrying of stone for the observatory commenced, and if the work lagged, it is said that the professor himself worked at stone-cutting with his own hands. In his diary for November 30, 1836, occurs this entry: "Went this afternoon to N. E. Mountain to quarry stone for my observatory." He raised some of the money for the observatory and paid for part of it out of his own pocket. To be exact and prosaic, the records of the trustees show that the observatory cost $2,075, that $1,200 was voted by the trustees, that $400 was contributed by friends, and that Professor Hopkins himself gave $475. The students too helped and in those days they often turned out almost in a body to help build the observatory which was to mean so much to them and the College. Such were the strenuous days of 1837!

* Some accredit this instrument to Troughton and some to Simms and the spelling is not always the same. A recent apparatus catalogue of Cooke, Troughton & Simms contains these historical statements:

"Of the three names represented in the title of the firm, that of Troughton is the earliest, his business dating back to the latter part of the seventeenth century. . . . . In 1826 the instrument business of William Simms was amalgamated with that of Troughton. . . . . Thomas Cooke first began to manufacture refracting telescopes at York in 1836."

The stone-work of the building was well along in the spring of 1837. An entry in his diary for June 29, 1837, reads: "Finished the stone-work of my building today. Felt solemn as the masons left. Felt as though I had not done my duty by them." In the spring of 1838 the observatory was nearly finished and it was formally opened with an address by Professor Hopkins on June 12, 1838. A woodcut of the observatory adorns the cover of the college catalogue for 1838-39. Albert Hopkins' title becomes Professor of Natural Philosophy and Astronomy and under observatory, apparatus, etc., appears this modest statement: "The lectures

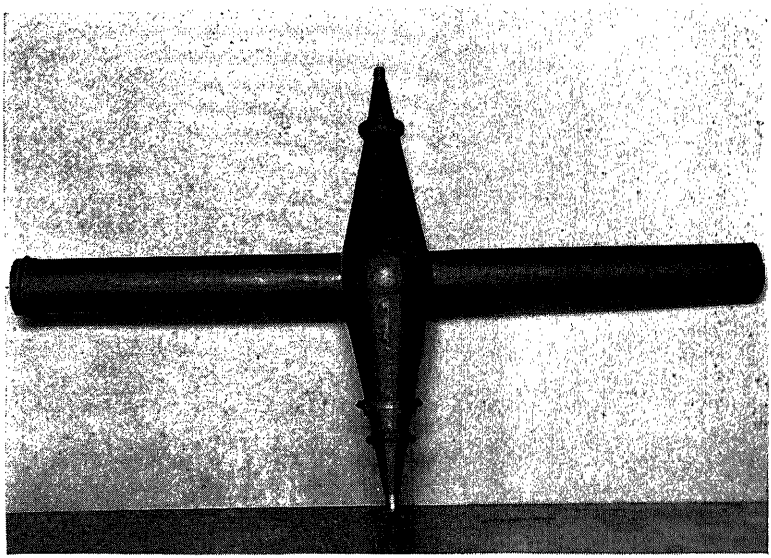


WOODCUT OF THE HOPKINS OBSERVATORY
(From the College Catalogue, 1838-1839)

in Astronomy are accompanied by celestial observations and instruction in the use of instruments. An observatory has been completed the past season supplying important facilities for these purposes."

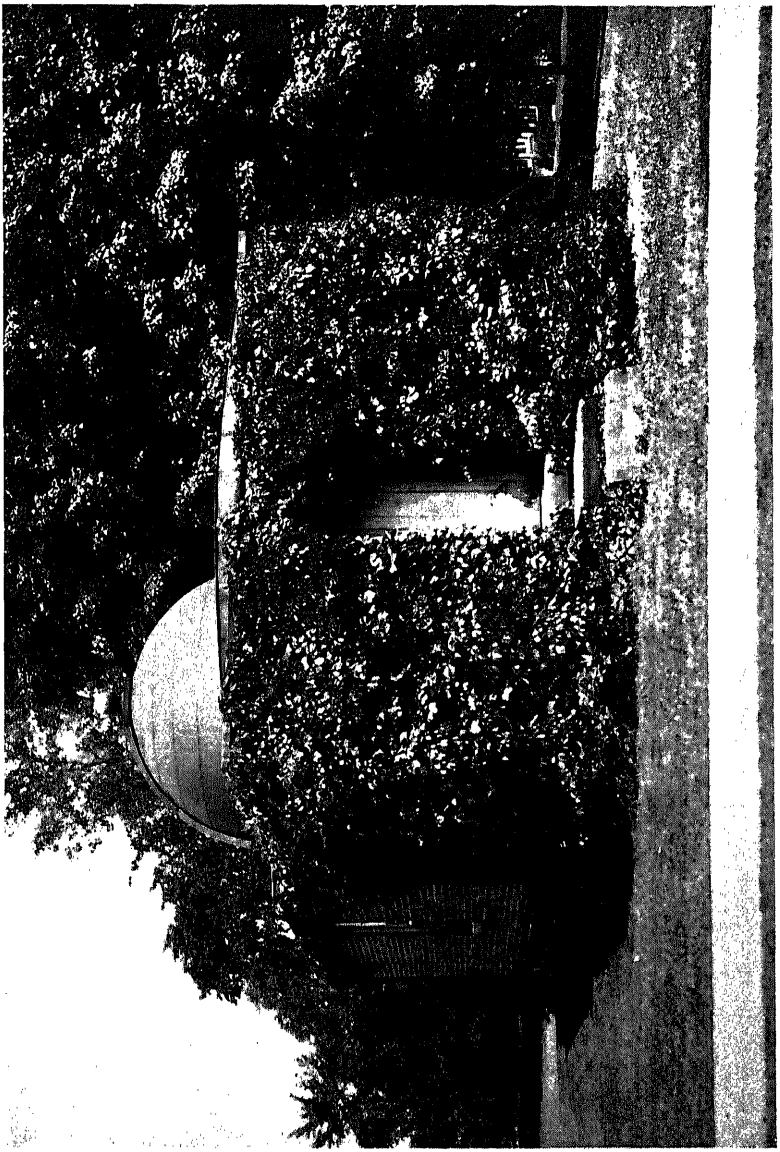
The Hopkins Observatory, as illustrated in the frontispiece, was built of native stone and consists of a central rotunda with two wings. It is surmounted by a revolving dome. The building is 48 feet long and the wings are nearly 14 feet wide. These are outside measurements. The central rotunda is octagonal on the outside and circular on the inside. It has a vaulted ceiling in the form of a hemisphere. This is painted blue and on it gold stars are grouped to form the constellations, and the circles

of the celestial sphere are also represented. This is a unique and original idea and reminds one of what is now projected on the inside of a modern planetarium dome. The wings have openings in the walls north and south and roof shutters. In the east wing the Troughton and Simms transit instrument, procured in 1834, turned between two white marble piers. It had a focal length of 50 inches, and an aperture of three and a half inches. The Molyneux sidereal clock was placed near-by. The transit



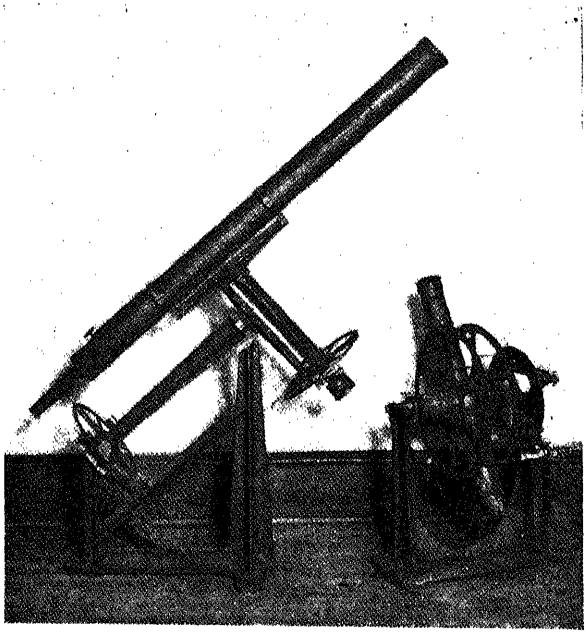
ORIGINAL TROUGHTON AND SIMMS TRANSIT INSTRUMENT

instrument continued in position until the building was moved in 1908. What is left of it is now an "antique" and in the "museum" in the rotunda. As far as is known nothing was ever mounted in the west wing. Under the revolving dome was placed a Herschelian reflector of 10 feet focus equatorially mounted. The circle for hour angle was a foot in diameter and the declination semi-circle was 30 inches in diameter. In 1852 the Herschelian reflector was replaced by a seven inch refractor. This instrument was procured through the generosity of Amos Lawrence of Boston and has an object glass by Alvan Clark, Sr., and a mounting by Phelps of Troy, New York. Although this



THE OBSERVATORY OF WESTERN RESERVE COLLEGE AT HUDSON, OHIO

was one of Alvan Clark's first object glasses, the instrument was considered at the time a very excellent one. The sidereal clock carries the name Molyneux and Cope, London, across the dial. This firm was in business in London from about 1820 to 1840, and nearly all of the sidereal clocks which came to America during this period were made by them. It is a grandfather clock with a brass movement, a mercury compensation pendulum, and an



THE TELESCOPE AND TRANSIT USED BY ELIAS LOOMIS AT HUDSON, OHIO
They bear the inscription: "Troughton and Simms, London, 1837"

anchor escapement. The hour hand moves over a small dial and the hours are numbered from 1 to 24. It is an excellent clock, still running after a hundred years, and giving a good account of itself.

The Observatory of Western Reserve College at Hudson, Ohio

Elias Loomis was born in the little hamlet of Willington, Connecticut, on August 7, 1811. He was graduated from Yale

in the class of 1830. He entered Andover Theological Seminary in 1831 and in 1833 was called to Yale where he taught Latin, mathematics, and natural philosophy. He was always very much interested in astronomy, terrestrial magnetism, and meteorology. With Denison Olmsted in 1835 he rediscovered Halley's comet before news of it arrived from Europe. In 1836 he was appointed Professor of Mathematics and Natural Philosophy at Western Reserve College at Hudson, Ohio. He studied in Europe from 1836 to 1837 before taking up his duties at Western Reserve. Considerable scientific apparatus, including the outfit for a small observatory, was procured during his stay in Europe. He returned in 1837 and remained at Western Reserve until 1844. From 1844 to 1860 he was Professor of Mathematics and Natural Philosophy at the University of the City of New York. In 1860 he returned to Yale and remained there until his death on August 15, 1889. He is chiefly known as the writer of many textbooks on mathematics, astronomy, and meteorology.

ELIAS LOOMIS
1811-1889

Harper's New Monthly Magazine for June, 1856, contains an article (pages 25-52) by Elias Loomis, LL.D., on "Astronomical Observatories in the United States." Here are his own words about the observatory at Hudson, Ohio:

> The next experiment for an observatory was made in Ohio, in connection with the Western Reserve College. Having been elected to the Professorship of Mathematics and Astronomy* in this institution in the spring of 1836, the writer was sent to Europe for the purchase of instruments and books, and returned in the autumn of 1837 with an equatorial telescope, a transit circle, and a clock. During the next season a building was erected, which,

* This is probably a mistake, his title being Professor of Mathematics and Natural Philosophy.

though quite moderate in dimensions, was well suited to the accommodation of the instruments. The entire length of the building is 37 feet, and its breadth 16 feet. The transit room is 10 feet by 12 upon the inside, having a sandstone pier in its centre. The pier is entirely detached from the building, and descends about six feet below the surface of the earth. The transit commands an unobstructed meridian from ninety degrees zenith distance on the south, to eighty-nine on the north.

The centre room is occupied by the equatorial. It is 14 feet square on the inside, and is surmounted by a revolving dome of nine feet internal diameter. The equatorial pier descends six feet below the surface of the ground, and, like the transit pier, has a slope of one inch to the foot.

The transit circle was made by Simms, of London. It has a telescope of 30 inches focal length, with an aperture of nearly three inches. The circle is 18 inches in diameter, graduated on platina to five minutes; and it has three reading microscopes, each measuring single seconds.

The equatorial telescope, made also by Simms, has a focal length of five and a half feet, with an aperture of about four inches. The hour circle is 12 inches in diameter, graduated to single minutes, and reads by two verniers to single seconds of time. The declination circle is also 12 inches in diameter, graduated to ten minutes, and reads by two verniers to ten seconds of arc.

The clock was made by Molineux, and has a mercurial pendulum. The instruments were first placed in the observatory September, 1838, and during the whole time of his residence in Ohio, the author pursued a systematic course of observations, as far as his engagements in the college would permit, and without the advantage of an assistant. Among these observations may be mentioned, 260 moon culminations for longitude, 69 culminations of Polaris for latitude, 16 occultations, 5 comets, with sufficient accuracy to afford a determination of their orbits, besides a great variety of other objects, for regulating the clock, etc.

The moon culminations observed at Hudson have been compared with European observations, as far as corresponding ones were made, and the following is the result: On 119 nights the moon was observed both at Greenwich and Hudson; on 107 nights it was observed both at Edinburgh and Hudson; on 95 nights at Cambridge (England) and Hudson; on 88 nights at Hamburgh and Hudson; and on 40 nights at Oxford and Hudson. The discussion of all these observations, the results of which are published in Gould's Astronomical Journal, has furnished the longitude of Hudson from Greenwich with a precision such as has been attained at but few other places in the United States.

In the summer of 1849, the observatory at Hudson was compared with that at Philadelphia by means of the electric telegraph, numerous signals having been transmitted to and fro on four different nights, and the difference of longitude between these places has thus been settled within a small fraction of a second. The accurate determination of the geographical position of a single such place in a new State, affords a standard of reference by which a large surrounding territory is tolerably well located through the medium of the local surveys.

The Observatory of Miami University at Oxford, Ohio

The *Miami Student* for November, 1904, contains an article by Dr. Robert W. McFarland on "The Old Stone Pier." Dr. McFarland was for a time Professor of Mathematics in Ohio State University and for a time President of Miami University. This article was solicited by Dr. Clyde Fisher, then editor of the *Miami Student* and now curator of the Hayden Planetarium in New York City.

The following material was taken from this article:

Forty or fifty yards southwestwardly from the south door of the main building, there is a stone pier, about three feet high and about two feet square. Almost every stranger who sees it, asks what it was for. The old stone pier long bore on its northwest face this inscription:

Designed in
1834
And erected in
1838
By John Locke, M.D.

More than twenty years ago some vandal defaced the stone and partly destroyed the inscription. John Locke was professor in the Cincinnati College of Medicine. He had been on the first Geological Survey of Ohio and delivered some lectures on Geology while engaged on the astronomical pier. The small transit telescope still in the University had been purchased of the Cincinnati College in 1836. The pier was made to suit the cast iron frame which supports the transit while in use. One of the iron fastenings is still on the old pier. After the pier was put in place here, in the early part of 1838, a small frame house was put over it. But in the course of a year or two, some persons, more inclined to pranks than to study, tore the building down and scattered the lumber around. The transit was replaced in the college apparatus room, and the building was never restored.

Additional Observatories

There are two more observatories which were built before 1840 but they were not entirely finished and the instruments were not put in place until after 1840. These were the Philadelphia High School Observatory and the West Point Observatory. In the year 1837 a committee was appointed by the Board of Controllers of Public Schools on the subject of establishing a central high school in Philadelphia. It was proposed to erect an observatory to be attached to the school. The tower was built in 1838

but the instruments were not installed until the autumn of 1840. At West Point in 1839 a large building was erected for the accommodation of the library and philosophical apparatus, with three towers for the reception of astronomical instruments. In 1840 Professor Bartlett visited the principal observatories of Europe and ordered three large instruments, an equatorial telescope, a transit instrument, and a mural circle. These two observatories will not be considered further.

There are five other observatories or quasi-observatories which perhaps for the sake of completeness should be mentioned.

Memorials looking toward the establishing of a first meridian in the United States at Washington were presented by William Lambert of Virginia in the House of Representatives as early as 1810, 1815, and 1818. They were approved by the House and Mr. Lambert was appointed to make astronomical observations in order to ascertain the longitude of the Capitol from Greenwich. Reports of these observations were transmitted to Congress by President Monroe in 1822 and 1823. Perhaps the observing stations of Mr. Lambert should be considered astronomical observatories.

In 1817 the city of Philadelphia granted the use of part of a building to the American Philosophical Society for an "observatory." The building was located at Center Square and was known as the Center Engine House. The portion placed at the disposal of the society was the southeast and northwest rooms in the basement story, the passage-way between them, so much of the circular part of the building as was above the basement, and the roof. Possibly the roof where instruments were set up and used should be considered an observatory.

The Franklin Institute Almanac, 1938, contains this:

> In 1820 an early observatory was established by William Riggs, maker and dealer of navigational instruments. This was long before the days of radio time signals, but ships using the Philadelphia port needed accurate time to set their chronometers. Riggs set up an observatory in the old State House, where time could be determined directly from the stars. The actual instrument that he used and the clock that kept official time for the city are now on display in the Hall of Astronomy of the Franklin Institute.

Haverford College was opened as Haverford School in 1833. In 1834 John Gummere was appointed Superintendent and Professor of Mathematics and Natural Philosophy. He was born in

Willow Grove, Pennsylvania, in 1784. In 1814, after teaching in several schools, he opened a boarding school of his own at Burlington, N.J. He was much interested in astronomy, and introduced natural philosophy in the curriculum of his school. He procured apparatus and supplies for this course from London at considerable expense. In 1822 he published an elementary Treatise on Astronomy which went through several editions. In 1833 he gave up his school in order to teach mathematics in the newly established Haverford School. After one year he was made Superintendent and continued as Professor of Mathematics and Natural Philosophy. It is said that as early as 1834 he erected a small observatory and placed in it his own apparatus and instruments. It appears in an old picture of the college as a small cylindrical building with a conical roof. In the late thirties there is an appropriation of two or three hundred dollars "for the laundry and the observatory". Courses on descriptive astronomy and on practical astronomy were early introduced. Professor Gummere retired in 1842 and died May 31, 1845. A sundial now marks the spot of this early observatory. In 1852 a stone building was erected as an observatory to house the eight-inch telescope by Fitz of New York and it is customary to date the Haverford College Observatory from this year. In 1883 another building of frame was erected to the south of the first and in it was installed the ten-inch equatorial by Clark. In 1933 these buildings were replaced by the present fine Strawbridge Memorial Observatory.

Edward A. Osse in his article on "Melchior van Osse" in *The New Age*, Volume XXXVIII, No. 1, January, 1930, says:

> Dominie Justus Falkner, and his elder brother, Daniel Falkner, Pietists, were members of the Theosophical Brotherhood that settled on the Wissahickon, near Philadelphia, in the Province of Pennsylvania, in 1694. The tabernacle that they built in the wilderness they surmounted with an astronomical observatory, the first to be erected in Pennsylvania and most likely in all America. Another proud distinction of Justus Falkner was that, in 1703, he was the first Lutheran minister ordained in America, the ceremony taking place within the consecrated precincts of Gloria Dei at Wicaco.

This observing platform atop the tabernacle may have been for watching Indians rather than stars.

Which Was the First Astronomical Observatory in America?

Referring to the Rittenhouse Observatories:

Lelande in his *Astronomie*, published in 1772, says: "In America, I know of no observatory but that of Mr. Rittenhouse at Philadelphia."

Stokley in his *Stars and Telescopes*, published in 1936, says: "But this deserves to be called the first American Observatory."

Maurice J. Babb in "Who was David Rittenhouse," *Leaflet 1, of the Rittenhouse Astronomical Society* says: "This, the first and for many years the only observatory in the United States . . ."

Goode in *Report of the Smithsonian Institution* 412, 1897 says: "His observatory built at Norriton in preparation of the transit of Venus in 1769 seems to have been the first in America."

Referring to the Yale Observatory:

Pendray in his *Men, Mirrors, and Stars*, published in 1935, says: "Yale University Observatory may therefore assuredly lay claim to being the first permanent observatory in America."

Referring to the Observatory of the University of North Carolina:

Dictionary of American Biography (in connection with Joseph Caldwell) says: "This was the first observatory established in connection with any educational institution in the United States."

Collier Cobb in "Some Beginnings in Science" in *Popular Science Monthly*, October, 1896, says: "But its interest for us to-day lies in the fact that it led to the establishment of the first astronomical observatory in the United States."

The Encyclopaedia Britannica in the article on observatories (14th edition) says: "The first American observatory is said to have been erected at Chapel Hill (N.C.) in 1831-32."

Referring to the Hopkins Observatory of Williams College:

Elias Loomis in "Astronomical Observatories in the United States" in *Harper's New Monthly Magazine*, June, 1856, says: "The first attempt to found a regular astronomical observatory in this country was made in connection with Williams College, Massachusetts, by Professor Albert Hopkins."

André, C. et Angot, A. in *L'Astronomie Pratique et Les Observatoires en Europe et en Amérique* say: "Le premier établissement des États-Unis qui mérita réellement le nom observatoire, celui

du collége Williams, à Williamstown, dans l'État de Massachusetts, a été fondé in 1836 par le Professeur Hopkins."

A. N. Skinner in "The United States Naval Observatory" in *Science*, n. s. Volume IX, January 6, 1899, pp. 1-16, says: "But the observatory erected by Professor Albert Hopkins of Williams College, in 1836, was probably the earliest establishment of the kind in the United States."

The New American Cyclopaedia, D. Appleton and Company, New York, 1861, Volume XII, Observatory article, page 472, says: "The first observatory building was erected in 1836 at Williams College, Mass., by Professor Hopkins."

A correspondent of the London *Athenaeum* writing from Boston in May, 1840, says: "The facts are these: — They have a small observatory in process of erection at Tascalvosa*, Alabama, for the use of the university in that place. Professor Hopkins of Williams College, Massachusetts, has a little establishment of the sort, and this is about all in that State — all in New England! The only other establishment in the United States, known to me, is that in the Western Reserve College, Ohio, under the charge of Professor Loomes."

It is interesting to note that the surveying stations put up by Mason and Dixon — one south of the city of Philadelphia, one 31 miles west in the Forks of the Brandywine, and one about 15 miles south of it — and used by them during 1763 and 1764 are considered by every one as simply surveying stations and not as astronomical observatories in any sense.

Consideration has been given to all *observatories* and not to *astronomical observations* made with instruments used in the open. Many astronomical instruments were in the possession of individuals even before 1700. Nearly every educational institution added a small portable telescope, a sidereal clock, and sometimes a small portable transit instrument to its equipment of philosophical apparatus almost as soon as it was founded. It was often many years before any observatory was constructed. Another article of even greater length could be written on all published astronomical observations made in America before 1840, the instrument used, whether used in the open or permanently mounted in an observatory, the method of making the observation, and the accuracy.

* Tuscaloosa is the more modern spelling.

Summary

Eleven observatories have been fully considered. They were all erected and equipped before 1840. Two of them were private observatories. One was a private observatory which developed into one owned by the United States Government. Eight were erected by educational institutions. These were:

The David Rittenhouse Observatories at Norriton from 1769 and at Philadelphia from before 1786 to 1796;

The Observatory of the College of William and Mary before 1789;

William Cranch Bond's Observatory at Dorchester from 1823 to 1839;

Yale Observatory in the Athenaeum Tower from 1830;

The Observatory of the University of North Carolina at Chapel Hill, N.C., from 1831 to 1838;

The private Observatory of Wilkes and Gilliss or the Depot of Charts and Instruments at Washington from 1833 to 1842;

The Observatory of Wesleyan University at Middletown, Connecticut, from 1836;

The Hopkins Observatory of Williams College from 1838 on;

The Observatory of Western Reserve College at Hudson, Ohio, from 1838 on;

The Observatory of Miami University at Oxford, Ohio, 1838 to 1840;

Harvard College Observatory at Danà House from 1839 on.

All of these were temporary or makeshift observatories or of fairly short duration with the exception of two. These are the Hopkins Observatory of Williams College and the Observatory of Western Reserve College (or Western Reserve Academy as it is now called) which followed it by less than a year. Both of these are still in existence in essentially their original condition. The Hopkins Observatory of Williams College is thus the oldest extant Astronomical Observatory Building in America. The reader is left to judge which was the first Astronomical Observatory in America.

Bibliography

The following list includes the books, pamphlets, and articles which contain material on early American Astronomical Observatories. The attempt has been made to have the list as complete as possible. All observatories built and equipped before 1840 have been considered. If an article has appeared in an abridged or modified form in several different places, they are not all necessarily included. The material is listed in no particular order. The books, pamphlets, and articles which take up several observatories are listed first. These are followed by the material on the separate observatories usually in the order in which the observatories are considered in this pamphlet.

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Dictionary of American Biography.
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